

ME441/541 Advanced Vehicle Systems
Spring 2021
Syllabus

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COURSE Monday : 1:40 am -3:30 pm @Zoom (Online)
SCHEDULE Tuesday: 3:40 pm-4:30 pm @Zoom (Online)

COURSE This course aims to provide basic concepts towards understanding electrified vehicles. It
OBJECTIVES aims to provide the students the technical fundamentals to build mathematical models of certain vehicle components, and perform simplified analyses on vehicle dynamics, battery behavior, energy consumption and power management.

After the course, the students should be able to :

- Identify different electrified powertrain alternatives.
- Understand the working principles and challenges of batteries, fuel cells and super/ultra capacitors.
- Understand the working principles of internal combustion engines and electric motors, their advantages and disadvantages.
- Create simplified vehicle component models in Matlab and Simulink.
- Be able explain the economic, environmental and social advantages and disadvantages of alternative vehicle technologies.

COURSE The intended content of the class is listed below. There might be small changes
CONTENT throughout the semester depending on how the class proceeds.

- Introduction : Introduction to different electrified systems, comparison to conventional vehicles, advantages, current situation of technology and market, challenges, environmental and policy issues.
- Vehicle Dynamics and Performance Fundamentals : Longitudinal Dynamics, Handling, Ride Comfort, Propulsion and Breaking, Modeling Vehicle Performance and Dynamics.
- Internal Combustion Engines : Fundamentals, types, efficiency maps, fuel economy, emission control.
- Electric Motors : Power and torque generation, types (DC motors, induction motors, SRM), efficiency.
- Powertrains : Powertrain technologies (Battery Electric Vehicles, Plug-in Hybrid Electric Vehicles, Hybrid Electric Vehicles), Alternative hybrid powertrain configurations (series, parallel, split), Powertrain simulation.
- Batteries : Electrochemical fundamentals, battery types, parameters, battery modeling, battery management systems.
- Alternative Energy Conversion Technologies : Fuel cells (fundamentals, types, hydrogen storage), supercapacitors, ultracapacitors.

COURSE There is not an officially assigned prerequisite for this course. However knowledge on
REQUIREMENTS dynamics, basic electric circuits and control systems will be required during the course.

Matlab and Matlab/Simulink will be used extensively. The course will require you to build models in Matlab and Simulink from scratch (with no prior template given). Therefore experience is strongly recommended.

There will be no recitations and limited number of problems will be solved in the class. This class assumes that you are interested in the material, that you will spare the time and effort yourselves to practice the concepts that are taught in the class and that you will reflect this to the assignments, exams and (if applicable) term project.

REFERENCES There is no official textbook for this course but the following references will be used occasionally:

- Iqbal Husain, *Electric and Hybrid Vehicles-Design Fundamentals, 2nd Edition*, CRC Press, 2011.
- Amir Khajepour, Saber Fallah, Avesta Goodarzi, *Electric and Hybrid Vehicles - Technologies, Modeling and Control: A Mechatronic Approach*, Wiley, 2014.
- James Larminie, John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2004.
- Gianfranco Pistoia, *Electric and Hybrid Vehicles-Power Sources, Models, Sustainability, Infrastructure and the Market*, Elsevier, 2010.

Additional materials will be shared at SUCourse when necessary.

ONLINE CLASS POLICIES

- Online lectures will be held via Zoom. Recordings will be shared through SUCourse+.
- You need to sign in to the Zoom lectures with your SU credentials.
- Students cannot share or post to the Web any document or recording of any of the course material with third parties.
- We are all responsible for creating a safe and inclusive classroom experience for everyone in the class.

ASSESSMENT & GRADING ME 441 Grading :

Homework (30%), Midterm (30%), Final (30%), Quizzes(10%)

ME 541 Grading :

Homework (20%), Midterm (20%), Final (25%), Term Project/Paper (30%), Quizzes(5%)

- Midterm and Final will be proctored exams. For proctored exams, your webcam and microphone should be on during the exam. In the case of non-compliance with this and other declared exam procedures, your exam will be void. Make sure to check that your webcam and microphone function properly before the exam. Exam dates will be announced at SUCourse+.
- Throughout the semester, random oral exams will be made. You may be called upon to explain your homework/project/exam solution and answer course related questions in a one-to-one meeting with the TA/instructor. Students who fail to explain their work or answer related questions will get zero (0) credit from the related exam/homework/project.
- Pop-quizzes with short answer questions (3-5 minutes) might be given randomly during classes. You must be present in the lecture for at least 40 minutes otherwise your quiz will be void. Your webcam and microphone should be on during the quizzes. Best 80% of the quizzes will be counted towards your final grade, therefore if you cannot submit a quiz due to connection problems you can consider it to be among your worst 20%.
- Your attendance and participation in the lectures may affect your final grade, especially

for borderline cases. Attendance consists of joining zoom lectures (you must be present in the lecture for at least 40 minutes) and participation in quizzes/polls.

- One make-up examination, covering the whole course material, will be given after the final exam date for the students who missed midterm and/or final examination **due to a valid excuse approved by the Health Services or University.**
- Homework will be distributed via SUCourse+. Zero credit for late homework unless arrangements are made in advance (only with valid excuses). You can discuss the problems/questions with your classmates but **copying work is against University regulations and might result in a grade zero (0).**
- All solutions (homework, exam and quizzes) must be written in a professional manner. You may lose points for poorly written answers.
- No extra homework/exam/project/etc. will be given to increase your grade at the end of the semester.

SUCOURSE+ All announcements will be made through SUCourse+, students are responsible from following the announcements.

DISCLAIMER

- Time conflict requests can be accepted for one hour only. Students who are registered to the course with time-conflict override accept the responsibility of any inconvenience that might occur due to missed content and/or (if any) quizzes. No make-up will be available for missed quizzes/content. To get approval for time conflict, you need to send an e-mail stating you are aware of these facts and you accept the responsibility.
- This syllabus and course details might need to be updated throughout the semester because of the uncertainties the pandemic brings. Any modification will be announced at SUCourse+ and also during the class. Students are responsible from following the announcements.

ACADEMIC INTEGRITY

- Students are expected to be familiar with and comply with [Sabanci University Academic Integrity Statement](#). Any form of academic dishonesty (plagiarism, copying/using other people's work, attending classes/exams on behalf of other people, etc) will be penalized with a failing grade (i.e., zero points) for the related assignment, quiz, or exam and **disciplinary actions will be taken.**